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ABSTRACT

The first (exploratory) phase of the Learning in Science Project focused on science teaching/learning in the Form 1 to 4 level (ages 10 to 14) and sought to identify problems and difficulties in several areas. Provided in this paper are comments obtained during structured/unstructured interviews (from students, ex-students, teachers, headmasters, science advisers, and inspectors) and observations made by project staff related to written resources. The intent in presenting these comments/observations is not primarily to provide a balanced view of the good and bad aspects of Form 1 to 4 science, but rather to open up problem issues as project staff and others see them. Comments/observations are presented and discussed as they relate to materials used by: Form 1 and 2 teachers to guide teaching; Form 1 and 2 students to guide learning; Form 3 and 4 teachers to guide teaching; and Form 3 and 4 students to guide learning. In addition, problems/difficulties with materials at the two levels are compared and contrasted. Included in appendices are additional comments focusing on traditional texts and more recent materials, and on reasons for using audio-visual resources (such as teaching abstract concepts using models and competing with audio-visual influences beyond the school). (JN)

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LEARNING IN SCIENCE PROJECT

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FOCUS ON WRITTEN RESOURCES

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WORKING PAPER No 11

The Learning in Science Project is an educational research project undertaken at the University of Waikato under contract to the NZ Department of Education. The project is initially investigating the problems and difficulties of Form 1 - 4 Science (10 - 14 year olds) as a first step to improving teaching and learning.

This paper is one of a set of essays which is an outcome of the exploratory phase of the project. It is our hope that feedback from these essays will assist further to clarify issues and assist us in establishing priorities for the in-depth phase of the project. Any comments our readers have on either the issues involved, or the methodology adopted in these papers, would be most welcome.

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A WORKING PAPER OF THE LEARNING IN SCIENCE PROJECT

Ross Tasker, Peter Freyberg, Roger Osborne

December 1979

This is one of a set of discussion papers which focus on various aspects of Form 1-4 Science. The paper collates comments and observations, related to the topic of focus, which were obtained during the first phase of the Learning in Science Project. In this phase we were particularly concerned about problems and difficulties in Form 1-4 Science and because of this the paper is biassed toward issues as identified by pupils, ex-pupils, teachers, headmasters, science advisers, inspectors as well as by our own observers. Our intention in writing the discussion papers is therefore not primarily to provide a balanced view of the good and bad aspects of Form 1-4 Science but rather to open up problem issues as we and others see them, to a limited but wider audience than the project team.

It is our hope that our chosen readers will be prepared to talk to us about the topic under focus in this paper in terms of the following questions:

(i) Are the issues we have raised important and central issues which are of general concern?

(ii) Are there other more basic issues, or other subsidiary questions, about the topic which we have overlooked?

(iii) Which aspects of the topic could we profitably analyze further in the in-depth phase of the project?

(iv) What possible solutions to some of the issues raised could profitably be the subject of further study?

INTRODUCTION

This essay considers printed materials that guide teaching and learning in Form 1 - 4 science. Such materials are written for a variety of purposes and can be used in a variety of ways.[1] We wish to distinguish clearly between two uses for such materials, namely the use by teachers to guide teaching and the use by pupils to guide learning.[2] Although material is usually written for a specific purpose or audience, much of it is used both by teachers and by pupils. For example, science library books may be used by teachers as resource material to aid in lesson preparation, and by pupils to aid in their learning. Textbooks written for pupils may also act as teacher guide material.

Unlike almost all other FOCUS essays we have found the differences between Form 1 - 2 and Form 3 - 4 so great, chiefly because of the difference in availability of resources for particular uses, that we will consider the class groupings separately in the first instance. The body of this paper therefore consists of four sections, which discuss in turn printed materials used by

(a) Form 1 and 2 teachers to guide teaching,
(b) Form 1 and 2 pupils to guide learning,
(c) Form 3 and 4 teachers to guide teaching,
(d) Form 3 and 4 pupils to guide learning.

In conclusion, we will contrast and compare the problems and difficulties at the two levels.

MATERIALS USED BY FORM 1 AND 2 TEACHERS TO GUIDE TEACHING

Written resources are extensively used in lesson preparation and direction at the Form 1 and 2 level. The principal material used by teachers in this way is the 'green books', the teachers' guides to the 1967 Form 1 and 2 syllabus produced by the Department of Education. Our observations suggest that for many lessons this resource is the sole external influence on what is being taught and how the topic is approached. This view is supported,

84/6/1 "Almost exclusively the schools I've seen are ones where the 'green books' are followed almost to the exclusion of any other direct resources."

[primary inspector]

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[1] The syllabus, which is also a written resource, is considered in FOCUS ON THE SYLLABUS.

[2] Audio-visual material is more difficult to classify and is considered separately in Appendix B.

Two readily apparent reasons why the 'green books' are so popular are that they are Departmental publications and many see the green books as useful.

73/3/3 "I've got used to using them [the green books] and I've found them very good and quite enjoyable too."

[primary teacher]

9/15/1 "I think the green books are really worth while - good experiments and well set out. At least they tell you at the end what the children should have got out of it so at least if you know [this] you can perhaps guide the children's thinking along these lines."

[intermediate teacher]

On the other hand a number of teachers consider the books do have considerable limitations.

27/2/3 "I have looked at it [the Green Book] for my Bio. unit that I'm doing on the cabbage community - and I found it very, very sketchy - but it suited me and I'm working more or less along the lines of that."

[intermediate teacher]

83/6/1 "When we first came over from England, I had to put [process skills] into the first and second form syllabus. Those green books were useless - they tell you to do this, that, and the other and they [the pupils] don't know how to do it anyway."

[Form 1 - 7 teacher]

27/8/2 "All you can get [in the way of assistance] is a very basic outline of concepts to be taught rather than how to actually teach them."

[intermediate teacher]

Some teachers have also expressed a concern as to whether the green books are guiding them in the right direction.

73/10/3 "The old approach [based on the green books] allowed me to teach the topic fairly comfortably [in terms of time] and also to teach the skills that I thought that they [the pupils] would need in the 3rd form. The only thing that annoyed me was that I didn't know what skills the 3rd form wanted."

[intermediate teacher]

27/7/3 "'terminal predator' [Green book No.] ... I think that was a particularly useless term ... I taught it because I thought well may be next year they'll be expected to know it and it might boost their confidence a little bit if they know what a terminal predator is - so that is the sole reason why I taught it. Not so much because I thought that particular piece of information is of real value to them."

[intermediate teacher]

The following comment from a retired secondary inspector who was familiar with the production of the green books reflects how some of the inadequacies in the material may have arisen.

58/13/1 "Bob Robert's trial material dates back to about 1963 and it was good, there is no doubt about it ... but that became the basis for the green booklets and any slips that Bob made are perpetuated because in facr all trial material at that stage became official material ... it was simply re-written by other people who perpetuated the mistakes and added their own...."

[retired secondary inspector]

Despite these perceived limitations the books remain popular. Undoubtedly this is partly due to the fact that many teachers consider that there is little alternative material available to guide them.

40/2/3 "There is not much [resource material] at the school really...it is a new school I suppose."

[intermediate teacher]

38/15/2 "You can get lots of books but quite often they just serve to confuse me because they - they get quite detailed about things."

[intermediate teacher]

9/1/3 "Well a difficult thing would be making sure that you have got the information."

[intermediate teacher]

However it has been suggested to us that the problem is in part due to a lack of awareness of some teachers as to what is available in their school.

9/10/3 "I wonder how many teachers [in this school] know that sort of thing is here?"

[intermediate teacher]

An example of a complementary, if not alternative, set of teachers' guide resources is the Infant - Standard 4 Trial Resource Units. A number of Form 1 and 2 teachers find these units useful, even if they are difficult to obtain,

23/4/2
9/11/1
24/10/1 "I think the little units the CDO are putting out are very good [Infant - Standard 4 Trial Resource Units] .... In fact we often go back to the primary school next-door and pinch some of his units. (You don't get the units? No - it's stupid."

[intermediate teacher]

38/14/3 "I liked the little standard four booklets - the little white ones - the little unit booklets [Infant - Standard 4 Trial Resource Units] - I find them good to use. I only ever used them last year when I had my first standard four class."

[intermediate teacher]

Finally in this section there is always the question of how much teachers' guide material should be provided for teachers.

39/1/3 "You can do so much for teachers and I think sometimes we do too much for teachers, but if they are not prepared to get in and do so much for themselves the thing's never going to fire ...its never going to go."

[intermediate teacher]

73/5/2 "It's over to the teacher how he conducts his lessons - I mean the books are only there as a resource."

[intermediate teacher]

In summary Form 1 and 2 teachers have had available to them specific teachers' guide material. Many teachers have used this material extensively, primarily we believe, because of a lack of suitable alternatives. We understand the Department intend to produce units similar to the Primer 1 - Standard 4 Trial Resource Units for use with the draft Form 1 - 4 Syllabus, and we believe such units will be eagerly awaited by teachers.

MATERIAL USED BY FORM 1 AND 2 PUPILS TO GUIDE LEARNING

At a time when teachers are being urged to have their pupils 'doing' science rather than 'being told' science it is perhaps rather surprising to find a great lack ofwritten resources available for direct use by pupils.

38/9/1 "A particular text relating to a particular area in the syllabus with [an associated] teachers' guide would be a great help."

[intermediate teacher]

83/12/3 "I had to work like mad to build up the library with books suitable to that age group [Form 1 and 2] on the science side."

[Form 1 - 7 teacher]

Some teachers also see the usefulness of such material not only to guide pupils in their learning but to guide teachers in terms of what to teach.

9/2/2 "[There is] a need for children's resources ... because they would even help the teachers ... because you would know that's the level the children should be working at."

[intermediate teacher]

Material to guide pupils in learning science can range from material which provides pupils with scientific knowledge, to material which purely guides pupils in their classroom learning activities. Lack of suitable material is particularly apparent with regard to the second type of materials and some schools have written their own material for pupils to use. Often this material takes the form of charts,

38/2/3 "I've written a lot of charts. The first year I came [to this school] was the first time I've used them but I'm gradually more convinced that they are - providing you can train your kids to use them - they are an excellent way of getting things across and developing individual study habits.

38/3/1 Most of the ones [units] we've done on charts, there is a minimum, or certain number of minimum tasks that they can do and to cater for those [pupils] that get ahead - that will finish that [the core] in a short time - there are enrichment tasks that they can do as well. Slightly more advanced extra work. One thing about these [wall charts] - they've got to be presented well and you've got to have plenty of illustrations and colour on them to grab the kids."

[intermediate teacher]

This approach may have the most potential to produce the ideal resource but as is hinted in the above statement there are problems.

23/7/1 "We try to keep the material as simple as possible but at times it is not easy, due to a variety of reasons - teacher ability, the pressure to get things done."

[intermediate teacher]

28/1/3 "The only problem with instructional material of the type we have developed is language in that children at the bottom end of the scale do flounder a bit."

[intermediate teacher]

While some teachers have the energy to write their own resource units many others will readily identify with this teacher.

73/5/1 "I don't get any free time - I want to redo what we are actually doing in science and go through the while thing again ... and we're due to do it."

[primary teacher]

In summary there is a lack of materials suitable for direct use by pupils to guide learning at the Form 1 and 2 level. Particularly with regard to materials to guide classroom learning activities some teachers have attempted to write their own materials. However lack of time, lack of resources to use in planning such materials, and possibly a lack of expertise and knowledge on the part of the teacher all make it difficult for good material to be produced in this way. The need for the Department or other external agencies to produce suitable material we believe needs serious consideration.

MATERIAL USED BY FORM 3 AND 4 TEACHERS TO GUIDE TEACHING

In the past, at the secondary level, little teachers' guide material from Department sources has been provided for Form 3 and 4 science, schools having been expected to translate the 1968 syllabus statement into a working scheme. This procedure has offered science H.O.D's the opportunity of developing approaches which match local requirements. However, such schemes, at least in some schools, appear to lack the detail necessary to guide classroom teachers lesson preparation and are therefore of only limited use.

22/11/3 "Schemes tend to be very vague because they are written by people who know how deeply they are to go into it ... and they don't go into any detail about how far ... sure, they list the topics covered, but topic depth can be anything."

[secondary teacher]

The response of some teachers to this situation is to use the pupil text-book - which may include teachers' guide material - as their scheme.

22/11/3 "...I think most teachers when they start off use their textbook as their scheme ... I know I did [in my] first year ... that was really the best thing [to do]."

[3rd year secondary teacher]

35/7/1 "Because the textbook goes along a particular way, that has been the teaching method. I think the resources are controlling the teaching."

[secondary inspector]

Whether this is done to the extent suggested in the above comment or not, there is little doubt that the textbook is a powerful influence on teaching and learning in Form 3 - 4 science - for good and for bad.

20/4/1 "At the beginning of each chapter I usually outline for them [the pupils] - take them through the chapter and show them basically what we are going to do."

[secondary teacher]

15/2/1 "It was all out of a textbook ... you just read and hoped that you understood."

[ex-pupil]

12/16/3 "We had our textbooks and that was it ... we would either look through the book and summarize it or the teacher would write things on the board and we would copy them."

[ex-pupil]

The influence of written material is also apparent where individualized approaches to teaching and learning are being based on overseas materials [ASEP, Scottish Integrated Science, ISCS materials]. This situation can mean that teachers need to think less about the planning of teaching and learning, since such printed materials not only spell out what is to be taught but suggest in detail how it might be taught.

On the other hand, while it is not uncommon for teachers to plan lessons very much in terms of one particular pupil text book or set of resource materials, there are teachers who are planning their teaching without being dominated by a single resource. For example,

20/18/3 "I use 'Science for the Seventies Bk I, Mk II' - I much prefer it to Mk I, I use it as a reference rather than a text. I use the reading assignments - they are pretty useful. I use the experiments when I feel the experiment is what I want or I'll use something else."

[secondary teacher]

However these teachers sometimes find difficulty in getting the range of resources they would like.

23/15/1 "My biggest problem was finding the right resources to teach what I wanted to teach ... they were there but you had to search through this book and that book to find them."

[secondary teacher]

25/16/3 "I find [it] difficult ... to get the resources that I want to use ... that is the written resources."

[H.O.D. science]

In schools where a variety of text books are available, and especially where pupils are not issued with one particular text book on a long term basis, teachers are encouraged to think about their teaching and can choose the text books that best fit their needs for a particular topic.

23/15/2 "We don't issue the kids with a text book ... we have a resource room full of different books and we - perhaps you use one book for one section or topic and then you use another for another section - which is good because you get the best of what's available."

[secondary teacher]

21/11/3 "It is good to have a variety of approaches where the kids are in fact motivated themselves and going at their own pace ... others where they are going more in step and other units which also require research and library work as well."

[P.R. junior science]

However, in spite of exceptions what is being suggested in this section is that because of a lack of material written specifically to guide teachers, the text book or set of pupil resources tends to be used to guide teachers in how and what should be taught. This influence is undoubtedly greatest when a single text book or package of materials is used by teachers but is also present when a variety of text books are available.

MATERIALS USED BY FORM 3 AND 4 PUPILS TO GUIDE LEARNING

Although, as has earlier been described, there are schools where teachers employ a range of pupil resource material, in the typical school situation a single text book is used as the dominant written resource by pupils to guide learning. What comments do people make about the text books commonly used in schools?[1] Firstly there is the range of pupil ability that cannot be met by one text book.

36/5/1 "The thing that I hate about 3rd and 4th form science would be the stupid text books we had to use. Because it's those really dumb ones where they give you a sentence and you have to fill in the one word ... and do the experiment and you can see this happening and this should happen and then you've got to fill in the blank about what it is and it was so frustrating because once again you could never show you knew it ... there was no scope for individuality. With the experiments they just followed it through and they told you what was going to happen."

[6th form pupil]

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[1] Specific comments about currently available text books are provided in Appendix A(i) and (ii).

8/2/1 "A number of pupils are obviously struggling because they haven't, in fact, got material that they can obviously cope with ... sometimes the language is too difficult ... sometimes the text book is too difficult ... and in some text books the reading age is above the teading age of the average [pupil] in that particular class."

[Teachers College lecturer]

25/4/1 "You have seen the resources that we have got here which are fairly good. They still don't cover a wide range [of ability] ... there are holes."

[secondary teacher]

8/2/1 "Another problem ... which I have seen is [the problem] of obtaining material for children below average ability - material of a suitable ability for them to get to grips with and particularly now the schools are tending toward multi-ability groups rather than rigid streaming."

[Teachers College lecturer]

In addition to the more obvious problems where pupils simply can't read the text, understand the diagrams or follow the instructions, there are more subtle problems in learning which are more difficult to identify,

17/23/1 "I think there is a great deal lacking in the 3rd and 4th form text book area. [I am] very disappointed in it actually - I'm not really able to say much more than that."

[secondary teacher]

Why is this teacher not sure? We have discussed elsewhere the problems pupils have sometimes in comprehending the text book [see FOCUS ON THE LEARNER] Pupils do seem to have real problems in understanding scientific ideas and undoubtedly they sometimes don't find the text books helpful at all.

"[Don't you think the book explains it very well?] What - the book! No, it doesn't explain it at all ... not to me.

These are complex problems, not simply just problems with text books, [see FOCUS ON KNOWLEDGE] and we will not pursue them further here.

In spite of uneasiness with and perceived deficiencies in available text material secondary teachers do not appear to produce their own written materials to the same degree as primary teachers. They tend, presumably because a range of texts are at least potentially available, to look for new published material. On the other hand, they do produce some work sheets, texts, and other similar material for use in their classrooms. We have had little comment from secondary teachers about this aspect of their work except, of course, that it is time consuming.

A consequence of the time and financial constraints which influence such home produced material is that it may reflect poorly against commercially produced materials.

20/12/3 "I do think we litter our science classrooms with far too much amateurish garbage on the walls. The kids have an expectation of science that material be professionally presented - I think that teachers have got to be a lot more careful about the way they present information."

[H.O.D. Science]

However of course it would seem such criticism must be weighed against the obvious advantages of such home-developed material. On the other hand teachers' resource centres are now providing facilities where teachers can get ideas and achieve a high standard of presentation. Material developed in such centres is now in evidence in classrooms.

In summary, unlike Form 1 and 2 teachers, the teachers in secondary schools have available at least one text book, and sometimes more, for use to directly guide pupils in their learning both in terms of acquiring scientific information and guiding classroom activities. There are naturally some inadequacies in this commercial material and to some extent teachers do supplement the material with home produced resources.

CONCLUSION

In Figure 1, three levels of written resources are detailed. A syllabus which sets out the limits of what is to be taught, teachers' guide materials which make suggestions as to how the syllabus might be actioned in the classroom, and pupil materials which specify what pupils should do and learn in particular lessons, as well as exemplifying to teachers what and how science can be taught.[3]

In theory, the syllabus should perhaps have the biggest influence on teaching. In practice we consider the available pupil material has a very big influence indeed. At the Form 1 and 2 level the lack of pupil material has teachers, many of whom have weak science backgrounds, unsure and ill at ease about the teaching of science. On the other hand we would suggest that the limited availability of a variety of pupil material at the Form 3 and 4 level, and the lack of teacher guide material, means that the pupil material that is available is having an undue influence on science at the secondary level.

What is the most desirable situation with regard to written resources? Presumably a carefully reasoned syllabus, which is straight-forward and clear to teachers in terms of what is to be taught in terms of content, skills and

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[3] Pupil material specifies to pupils either what to do (as in experimental work) or conveys information. Other methods of carrying information and ideas apart from text books and worksheets include audio-visual aids. These have an important, but not a central place, in the teaching of science at least at present. Audio-visual resources are discussed in Appendix B.

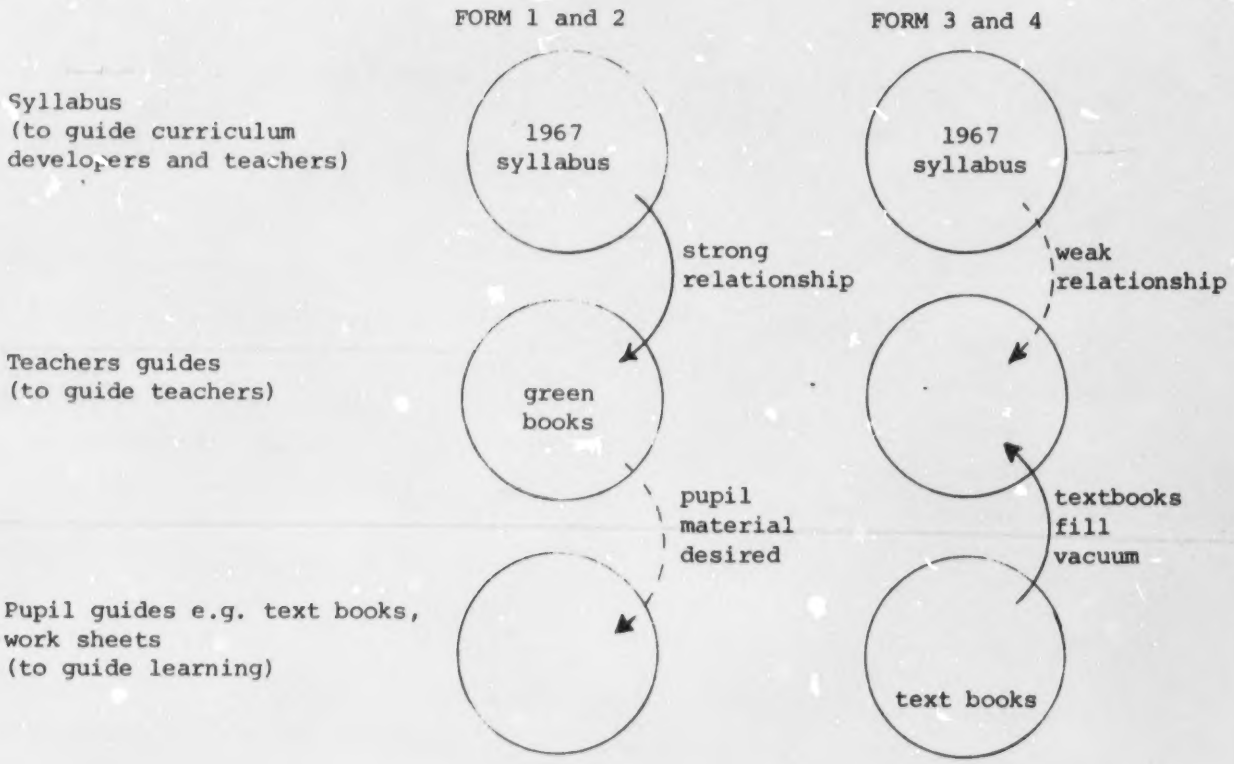

Fig. 1. The situation with regard to written resources in New Zealand Schools during the 1970's.

attitudes, is a prime resource. Clear teachers' guide material, which exemplifies to teachers how these goals might be achieved in the classroom on an almost lesson-by-lesson basis, is almost as important. Preferably it should detail a variety of procedures which might be used, depending on the teacher. the class and the physical resources.

6/8/2 "there needs to be lots of suggestions of the different ways you can do it."

[secondary science adviser]

Finally there should be a variety of pupil material to back up the suggested methods as outlined in the teachers' guide.

What of the present and the future? As we understand it teacher guide material is being prepared at the Form 1 and 2 level. The quality of this material is not known at this stage but the procedures by which the material is being developed suggests the quality will be 'variable'. We have only one teacher comment about one topic of this trial material. Nevertheless we doubt if it will be a unique comment

39/9/2 "The basic criticism I have [about the trial unit] is the lack of teacher question direction ... the key questions they ask contain so many assumptions about what the kids would know ... where they are up to ... what they have got out of it ... and the questioning is the vital area."

[intermediate teacher]

As we understand it there is no intention of providing pupil material at that level at least in the forseeable future.

At the secondary school level the Department of Education is producing teachers' guide material for the first time. We also understand the text book writers are already in action ....

6/8/3 "already people are writing text books to go with the draft [syllabus] ... they want to make a killing .... I am fed up with text book writers because you know they make all these mistakes ... too high reading levels ... what worries me is that schools are going to grasp this material and that will become their scheme."

[H.O.D. Science]

If this is so it raises some very fundamental questions. Who should be writing the text books? While the Department of Education puts effort into syllabus and teacher guide material what influence will it really have? Perhaps government effort should go into licencing text book writers?

What is clear is that the writing of a syllabus is not enough. What must be considered is syllabus, teacher guide material and pupil material. Has anyone really thought this all through? Where are we going?

This aspect of Form 1 - 4 Science has also considerable implications for the Learning in Science Project. For example should the Project in the action research phase be concerned about modifying the syllabus, modifying or producing teachers' guide material or should we be concerned about producing pupil material? What will have most impact on teaching and learning?

Our views on this are beginning to show! What do you think?

ACKNOWLEDGEMENTS

We are grateful to all those people who so freely talked to us about F1-4 Science. We also wish to thank the teachers and pupils who so willingly allowed us to join them in their classroom activities.

With regard to the preparation of this particular paper, we are grateful to our colleagues, Bev Stead and Keith Stead, for valuable discussions.

APPENDIX A. COLLECTED COMMENTS ON SOME FORM 1 - 4 WRITTEN RESOURCES

These comments suggest a useful role for almost all resource material. They also serve to indicate that no single resource is likely to fulfil all requirements - especially in mixed ability classrooms.

i. Relating to more traditional texts.

21/11/2 "We use 'Science makes sense' as a reference material."

[P.R. Junior Science]

21/15/2 "'Science makes sense' has too high a reading age for many of the pupils."

[secondary teacher]

16/7/2 "I thought the 'Science makes sense' books were better - you know - for writing up the notes - but there seems too much writing in the others ['Science for the Seventies'] - you have to write up everything."

[ex-pupil]

21/15/2 "'Science for the Seventies Bk II, Mk I' has a reasonable reading age for the 4th Form ... but it hasn't got enough depth - that the Mk II covers - in some areas."

[secondary teacher]

21/11/1 "'Science for the Seventies'. the 4th form Mark II book is written quite well, at quite a good level I think. The 3rd Form 'Science for the Seventies' Mark II book is far too advanced for the 3rd form ... I think that at least to some degree it has been a mistake ... it is too advanced ... the Mark I was too simple."

[P.R. junior science]

43/3/3 "It wasn't too difficult to understand. No, in the third and fourth form those books ['Science for the Seventies'] were really good."

[ex-pupil]

25/15/2 "With both the forms [4th forms] I have got the old 'Science for the Seventies' which has kind of forced me to go and look for other things to back it up."

[secondary teacher]

74/6/3 "I had a look at 'Science for the Seventies' and I didn't like it ... it was just too simple - it gave little drawings of what was going on - gave you answers of what was going on - asked you questions about it - just didn't seem anything to think about."

[ex-pupil]

25/11/3 "'Matter, Energy and Life' is about the right level for the kids [fourth form]."

[secondary teacher]

84/6/2 "Sometimes I still see the old UNESCO resource book and I feel that's a very practical and very useful book."

[primary inspector]

ii. Relating to more recently available material.

17/23/1 "I've had a look at the ASEP units and I think although the idea is good the way they treat the pupil - they treat them as an immature sort of imbecile sometimes."

[secondary teacher]

21/11/2 "The ASEP units are being trialled [by the school] for the first time - variable success with them ... but I think we are all finding our way a bit - floundering away ... because most of us have never used individualised or small group work ... you know self-paced work styles."

[P.R. Junior science]

18/1/3 "There is a lot of reading in the ASEP [material] and I have found with the top band they really enjoyed it ... they steamed along at their own pace but with the lower band there were certain reading difficulties and perhaps a fair amount of guidance was required as far as the text itself was concerned."

[secondary teacher]

APPENDIX B. AUDIO VISUAL RESOURCES

One aspect of written resources used directly with students are audio-visual resources, for example overhead projector transparencies, film strips, film loops and video tape. Such material can be used by the teacher in a formal situation, or directly by pupils working individually or in groups.

The teachers we have talked to have a variety of reasons for considering such audio-visual resources desirable.

(a) to teach abstract concepts using models

17/18/2 "audio-visual aids can help bring a topic or the concept that much more to life."

[secondary teacher]

17/15/3 "I feel that a lot of the things we are talking about ... they are often abstract ideas or we are looking at physical things with abstract concepts attached to them and audio-visual aids ... they can certainly help ... what you see really looks and makes an impression."

[secondary teacher]

80/6/3 "If we could pull out something [video, film, 3D models] that reinforces the point graphically and well then we can't fail [with the concepts associated with 'Particle nature of matter'] as much as we are failing now."

[secondary teacher]

80/1/7 "The more teaching aids we can put in - especially when dealing with abstract terms - [the better] where kids can be exposed to different ways of looking at the same thing."

[secondary teacher]

(b) to teach aspects of science beyond pupils' possible experience

17/1/3 "I used a recording of the moon-landing I have, it's 10 years ago now and these kids know nothing about it, they sat glued for 20 minutes."

[secondary teacher]

17/1/2 "I looked at the astronomy [unit] - its lovely pie-in-the-sky but how the heck - the things they suggest would be of the type that the teacher does in the classroom without the kids being able to do any practical or see anything - to be able to see anything in any detail the telescope needs to be of a quality that schools can't afford - I still feel that southern hemisphere astronomy should be taught but I'd still like to know how you do it so that it is not dead boring for the kids - I know [a teacher who] has a good slide collection - this is one way you could do it so they have something to do other than just sit in the classroom."

[secondary teacher]

21/6/3 "Space and time ... astronomy would lend itself to video programmes that were produced competently."

[secondary teacher]

(c) to diversify the methods of teaching

21/6/3 "Video is a good as the kids get a different sort of reinforcement."

[secondary teacher]

20/12/2 "Professionally prepared overheads are reasonably good and teacher prepared overheads and this tupe of thing go a long way to vary the lesson or make it seem more professional and more attractive to pupils."

[H.O.D. science]

17/17/2 "A screen always draws attention - O.H.P's, slides, T.V."

[secondary teacher]

(d) to compete with the audio-visual influences beyond the school

17/16/1 "We are competing with audio-visual message outside of school - we are competing with T.V. and films and records ... T.V. is a powerful education tool if we would only use it."

[secondary teacher]

However they also comment about problems; about shortages of both soft and hardware;

20/12/2 "I think we [teachers] should take advantage of their [pupils] respect for things that are professionally presented but of course, this can only be done when there is an adequate supply of overhead projectors and the Department have been rather slow in making overhead projectors available - there are a lot of outstanding orders right around the country that are at least 12 months old."

[H.O.D. Science]

17/13/1 "I honestly feel that the department should make a move to provide schools with better audio-visual equipment. I think they are very slow in coming forward in this direction."

[secondary teacher]

20/11/3 "That set of overheads on Human Reproduction put out by the Department - that set is one of the few professionally prepared things that you can use in 4th Form Science."

[H.O.D. Science]

about inadequacies in some material;

21/6/3 "There have been one or two programmes that have been produced on T.V. that have been terribly boring ... it has got to be appropriate and interesting to hold the kids interest."

[secondary teacher]

about inadequacies in management;

17/16/3 "I'm astounded at the lack of organisation - in fact the thing that shocks me most is the haphazard development of the video set up in this area. The master library is at ____ school - we have no list of what they have got."

[secondary teacher]

and about a 'catch 22' situation that schools are in.

17/17/3 "I'm a great believer in audio-visual aids although at the moment this school, which is typical of many others, they are not exploited one-tenth as much as they could be. The slides - they had a dozen film strips - most of them pretty poor quality which are seldom used. They have a few pretty bedraggled slide projectors lying around, it's a real effort to get an O.H.Projector - it all comes down to money ... the school can't afford much more."

[secondary teacher]

Clearly audio-visual material has much to offer Form 1 - 4 science and it would seem from the above comment that development, particularly of software is slower than some teachers at least would like. At the pragmatic level it is perhaps the last comment which identifies the crux of the matter, much material has been made available in the past by the Department which is not well utilized, on the other hand it is easy to see why! Whatever, it would seem certain that this is a future growth area and obviously with this growth there is much to gain but only if material is carefully produced,

80/7/1 "You think with your adult knowledge it's a great thing for them to see [films using models] but in actual fact at their level it's not."

[secondary teacher]

80/3/6 "We gave them a test on the film [Donald Duck and Maths] to see what the kids had learnt - and the kids had learnt more about funny things that Donald does and not the concept it was supposed to show!"

[secondary teacher]

and teachers develop acceptable strategies of using it.

36/12/2 "(What do you really dislike doing?) Going for film strips because they get a film strip and they keep on the same bits for about half an hour - and you get told about it for about five minutes ... I reckon they [teachers] could spend their time a lot better than just showing film strips."

[intermediate pupil]